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Paul Westrich, Andreas Knapp & Ingrid Berney

Megachile sculpturalis Smith 1853 (Hymenoptera, Apidae), a new species for the bee fauna of Germany, now north of the Alps

Abstract

In 2015 the bee species *Megachile sculpturalis* Smith 1853, originally native to East Asia, has been detected north of the Alps for the first time. Hitherto, this adventive species was only known from south of the Alps with areas in southern France, northern Italy and southern Switzerland colonized since the first European record in 2008. One of the locations reported here is the town of Langenargen, Germany, at the northern lakeshore of Lake Constance; the other one is the city of Zürich, Switzerland. At both sites females have been observed nesting in man-made wooden nesting aids for solitary bees and wasps put up in private gardens. At the German site 14 nests had been built. For this reason *M. sculpturalis* has to be added as new to the list of German bee species. A brood cell in one of the German nests contained exclusively pollen of *Styphnolobium japonicum*, an exotic tree that seems to be very attractive as a pollen source and may promote the further spread of *M. sculpturalis* in central Europe. We discuss how the arrival of the species can be explained.

Zusammenfassung

Im Jahr 2015 wurde die ursprünglich in Ostasien beheimatete Bienenart *Megachile sculpturalis* Smith 1853 erstmals nördlich der Alpen nachgewiesen. Bislang war sie nur südlich der Alpen bekannt, wo sie Gebiete in Südfrankreich, Norditalien und der Südschweiz besiedelt hatte, seit sie 2008 in Allauch bei Marseille erstmals in Europa festgestellt wurde. Einer der beiden neuen Fundorte ist die Stadt Langenargen (Deutschland), der andere die Stadt Zürich (Schweiz). An beiden Stellen wurden Weibchen beim Nestbau in Nisthilfen aus Holz beobachtet, die für solitäre Bienen und Wespen in privaten Gärten angebracht waren. In Langenargen wurden insgesamt 14 Nester gebaut, die mit Harz und sandigem Lehm verschlossen wurden. Die Pollenanalyse des Larvenproviants in einem der Nester aus Langenargen ergab ausschließlich Pollen von *Styphnolobium japonicum*, einem exotischen Baum, der eine besonders attraktive Pollenquelle für die Bienenart zu sein scheint. Auf welchem Weg die Biene in den Raum nördlich der Alpen gelangt ist, wird diskutiert.

Introduction

In Europe many bee species are in a serious decline (Nieto et al. 2014). According to the German Red Data List 39 out of 564 species are considered as already extinct on a national level, 52 % are threatened or endangered (Westrich et al. 2012). On the other hand, there are bee species that have expanded their distribution range in recent times, colonizing large areas where they have never before been recorded. *Colletes hederae* is a good example of this (Bischoff, Eckelt & Kuhlmann 2005, Cross 2002, Frommer 2010, Herrmann 2007, Jacobi et al. 2015, Tischendorf, Frommer & Chalwatzis 2007, Westrich 2006). Furthermore, there are species that occur suddenly and unexpectedly. One of those species is the adventive *Megachile sculpturalis* Smith 1853 which originally occured in Japan and countries on the South-East Asian coast. In the 1990s this species was introduced to North America (Mangum & Brook 1997) where it has rapidly expanded throughout several states (Hinojosa-Diaz 2008, Hinojosa-Diaz et al. 2005, O'Brien and Craves 2008). In 2008 the species was reported for the first time in Europe at Allauch near Marseille, France (Vereecken & Barbier 2009). It was also reported in Italy in 2009 (Quaranta et al. 2014) and the Canton of Ticino, southern Switzerland in 2012 (Amiet 2012). In 2012 it was reported breeding successfully in southern France (Gihr & Westrich 2013). Since the first discovery near Marseille the species has been found at an increasing number of locations in Europe south of the Alps. The rapid expansion in Europe is again confirmed in 2015 by finds north of the Alps. Details of these records are documented here and contribute to the surveillance programme that Quaranta et al. (2014) have proposed to monitor the spread.

Results

On August 23, 2015 A. Knapp discovered a female of a very large bee on a wooden nesting aid for solitary bees (figures 1 to 3). The nesting aids were placed in a private garden in Langenargen, a town at the northern lakeshore of Lake Constance (47.36N, 9.33E, altitude: 399 m). Since the species was unknown to him he took several photos for a later identification. At home he searched the internet and found corresponding images in various web sites and in a publication about a breeding record of *M. sculpturalis* in the northern Provence (Gihr & Westrich 2013). Due to the remarkable similarity between these images and his own photos he contacted the first author and requested a confirmation of his identification. P. Westrich realized the faunistic significance of this record and requested further details of Knapp's observations. This publication reports our observations.

In addition to this record from southern Germany there were two more made in 2015 in northern Switzerland and displayed in an online map of the Centre Suisse de Cartographie de la Faune (CSCF). One of the finds (by Franz-Xaver Dillier) was near the Lake of Lucerne. No further details are known to us. The other record originates from a private garden in the city of Zürich in the vicinity of the Sihlfeld graveyard (47.37 N, 8.50 E, altitude 415 m). A short video and several photos made by Daniel Keller dating from July 12, 2015 showed a female entering and closing a nest in a 8 mm wide hole drilled in a block of oak wood (fig. #).

The photos made by A. Knapp (figures 1 to 3) undoubtedly a female of *M. scupturalis* with slightly worn wings. Obviously, the specimen must have been active for a long while. The wings of the female observed by I. Berney (fig. 4), were still intact, suggesting that this was at the very beginning of the flight period. On September 21, 2015 P. Westrich went to Langenargen and investigated the nesting site where the species had first been discovered by A. Knapp. He found 14 borings in two blocks of wood (pine and lark, 80 mm deep) with nest closures. The borings had a diameter of 8 mm and 10 mm and were placed to attract mason bees like *Osmia cornuta*. Nine nest closures were exclusively made of a very dark resin (fig. 7). In three closures the resin was completely covered with a sandy clay (fig. 9). In two further closures the outer clayey layer was not complete (fig. 8). The number of nest closures suggests that they were made by more than one female. This was supported by the owner of the nesting aids who was convinced that he had seen more than one specimen of the bee species in question. The female in Zürich used a rather dark resin to close the nest. The origin of a second type of material put on top of the resin could not be determined.

One of the Langenargen blocks of wood contained a single nest which was given to the first author. He had the idea of trying to open it, hoping to find some pollen. Using a saw and a sharp knife he managed this. He found only one cell and no prepupa but much pollen deposited as larval food. The reason for the missing prepupa is not known. The pollen analysis using the method described by Westrich & Schmidt (1987) showed interestingly enough, that the larval provision contained exclusively pollen from *Styphnolobium japonicum* (= *Sophora japonica*, Japanese pagoda tree) (Fabaceae). No other pollen was found in the cell. At the time of the discovery there was no specimen of *Styphnolobium japonicum* known in the vicinity of the nesting site. However, some time later, after the record had been published on the internet (Westrich 2015), several people searched for it and were successful in discovering a *S. japonicum* tree about 300 m away from the nesting site. It is not known which pollen was collected for provisioning in Zurich. A search revealed five Japanese pagoda trees 95 m and 280 m away from the nesting site.

Discussion

The record of *M. sculpturalis* at the northern shore of Lake Constance is the first one of this species in Germany. The activities of at least two females in 2015 make it appear very likely that these have emerged from a nest built in 2014 somewhere in the surroundings. Adding *M. sculpturalis* as a new species to the list of German bees is therefore well founded. In Zürich only one specimen, a female, was observed in 2015. The species is likely to be more widespread in Zurich.

The species was first recorded in Europe in Allauch near Marseille, France, in 2008 (Vereecken & Barbier 2009). Further records have been published from southern France (Gihr & Westrich 2013), from the Swiss canton of Ticino (Amiet

Figure 1. *Megachile sculpturalis* female landing on a nesting aid in Langenargen, August 23, 2015 (Photo: A. Knapp).

Figure 2. The same female as in figure 1. Look at the worn wing margins (Photo: A. Knapp).

Figure 3. *M. sculpturalis*. The same female as in figure 1. August 23, 2015 (Photo: A. Knapp).

Figure 4. *M. sculpturalis* female on a nesting aid in Zürich, Juli 12, 2015. The origin of the material used for the nest closure is not known. (Photo: D. Keller)

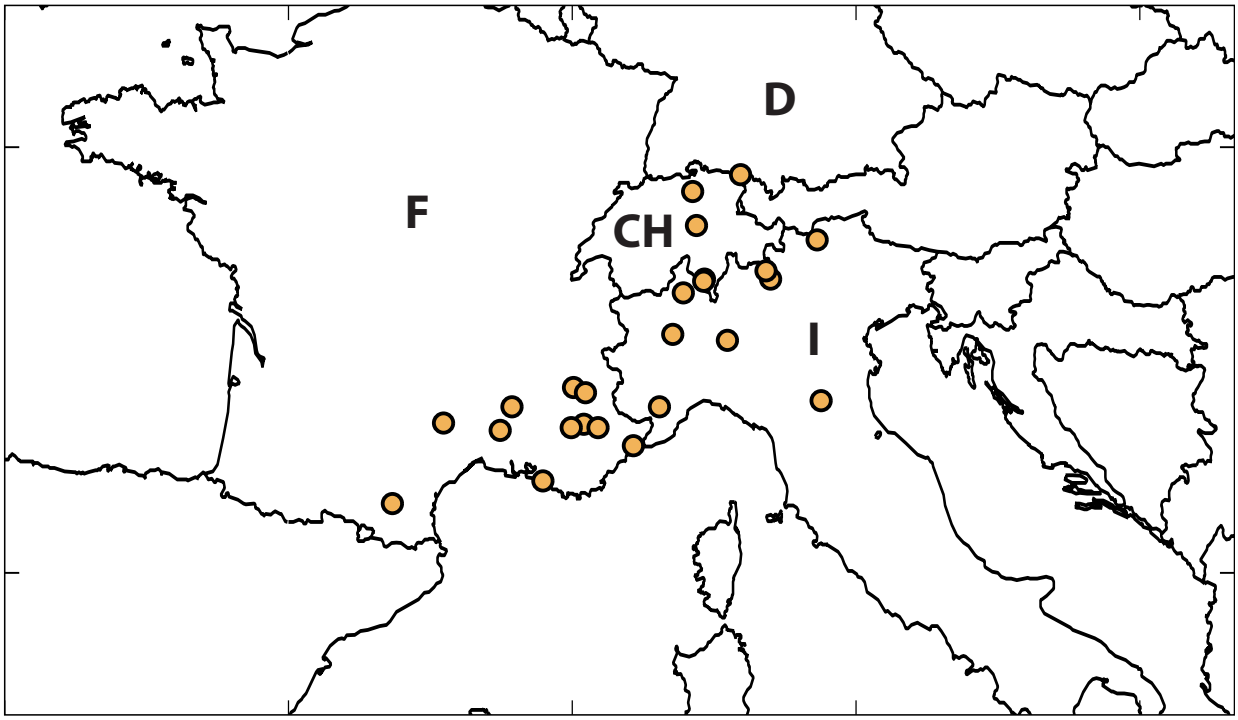

Figure. 5. Distribution map of *Megachile sculpturalis* based on European records from 2008 to 2015. Data from scientific publications, photos and messages on the internet, personal correspondence, unpublished records of the authors (status: October 31, 2015).

2012) and from northern Italy (Quaranta et al. 2014). In addition, a greater number of records illustrated with photos were reported in insect forums on the internet, others are presented in Flickr, an internet photo management and sharing application (https://www.flickr.com). Up to the end of 2014 the species had been found from the eastern French Pyrenees to the Italian Toscana, covering a straight-line distance of 760 km. The altitude of the locations range from 70 m (Allauch, France) to 1540 m (Matemale, Pyrénées-Orientales, France). All these records are situated south of the Alps. With the records in Langenargen and in Zürich the species has expanded further north. The straight-line distance between the southernmost record in Calenzano (FI, Toscana, Italy) and Langenargen is 450 km.

In order to present the current known distribution in Europe all available records have been entered on a map (fig. #).

Since all records of *M. sculpturalis* found in Europe until the end of 2014 were found south of the Alps, the question is how did the species reach the northern border of Lake Constance and the city of Zürich (and the area near the Lake of Lucerne)? The year of detection in Germany and northern Switzerland does not necessarily mean that 2015 is the year of arrival. Since the three locations are separated by the Alps, it is unlikely that the species has spread naturally from northern Italy or southern France to this northern region. If this would be the case, then it would suggest that there are populated locations in between that have not yet been detected. *M. sculpturalis* builds its nest in all kinds of cavities, so nests may have been transported in wood or other merchandise. This coincides with the assumptions made by Quaranta et al. (2014) who considered an introduction from France into northern Italy by lorries or trains or directly into Italy by shipping more likely than a natural dispersion.

On the other hand, large bees like *Xylocopa violacea* or *M. scupturalis* seem to have a strong tendency for spreading naturally in a short time. Therefore it can not be entirely excluded that the density of some of the occurrences, especially in southern France, are the result of active migration, similar to the one reported from North America (Hinojosa-Diaz 2008). Future monitoring may cast light on both assumptions.

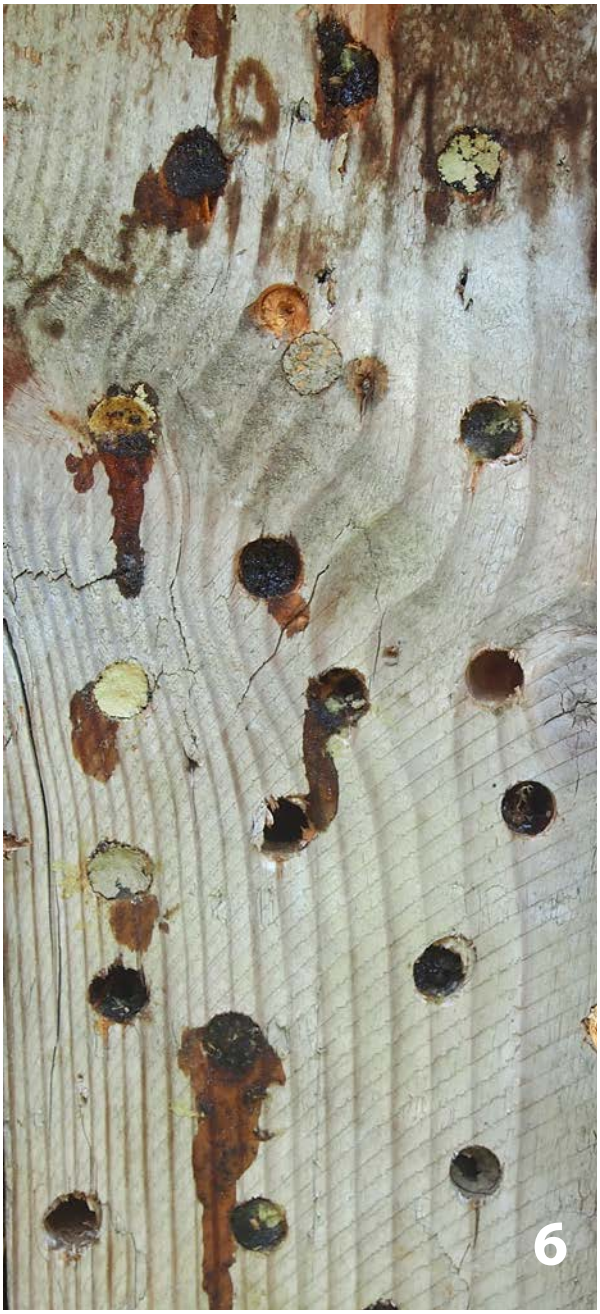

Figure 6. Wooden nesting aid with nest closures of *M. sculpturalis*. Langenargen, September 21, 2015 (Photo: P. Westrich).

Figure 7. Resin nest closure of *M. sculpturalis*. Langenargen, September 21, 2015 (Photo: P. Westrich).

Figure 8. The primary resin nest closure was only partially covered with a thin layer of sandy clay. Langenargen, September 21, 2015 (Photo: P. Westrich).

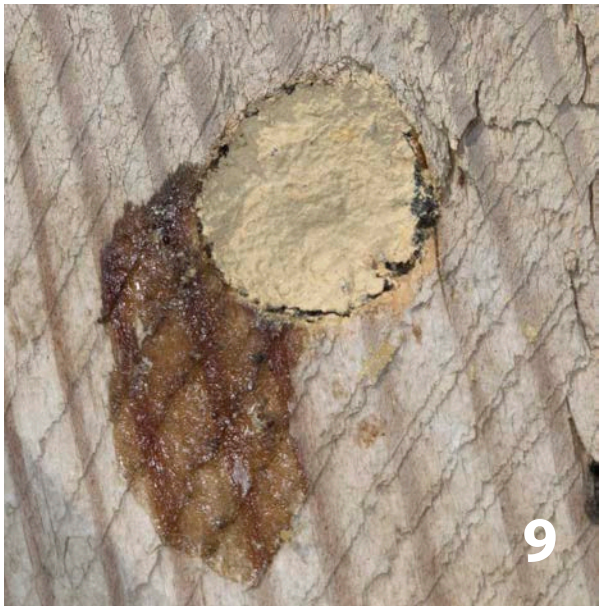

Figure 9. Nest closure with complete layer of sandy clay. Langenargen, September 21, 2015 (Photo: P. Westrich).

Nests from southern France were provisioned with pollen of *Styphnolobium japonicum* (Gihr & Westrich 2013). Observations of a pollen-collecting female made by P. Westrich in 2014 at several locations in the northern Provence and further pollen analyses of larval provisions have confirmed this. A brood cell in a nest found in Langenargen also contained, exclusively, pollen of this tree. Thus *M. sculpturalis* seems to prefer this tree for pollen foraging, at least in the areas studied. This partly coincides with observations in North America (Hinojosa-Diaz et al. 2005, Laport & Minckley 2012). On the other hand, Quaranta et al. (2014) analysed the pollen content of one brood cell and found *Ligustrum* (Oleaceae) as the most abundant pollen, followed by *Castanea* (Fagaceae). In Menton (France) U. von Haldenwang (pers. comm.) observed females collecting pollen from flowers of *Firmiana simplex* (Chinese parasol tree) (Malvaceae), but this is not yet confirmed by pollen analysis. This tree species is not on the list of hitherto known plant species foraged by *M. sculpturalis* which Quaranta et al. (2014) have compiled from published studies. However, this list does not distinguish between nectar and pollen sources. Nevertheless, *M. sculpturalis* can be referred to as a largely polylectic species, but seems to prefer *Styphnolobium japonicum* if it is available. This is why the authors suggest that the further spread of *M. sculpturalis* in central Europe will be strongly promoted by the occurrence of this tree, especially in urban habitats. Future studies will show if this assumption is true.

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Figure 10. *Megachile sculpturalis* male visiting *Origanum vulgare*. Digne, F, Juli 28, 2014 (Photo: P. Westrich).

Figure 11. *Megachile sculpturalis* male, frontal view (Photo: P. Westrich).

Figure 12. *Megachile sculpturalis* female, frontal view (Photo: P. Westrich).

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Authors' addresses / Anschriften der Verfasser

Dr. Paul Westrich, Raichbergstr. 38,
D-72127 Kusterdingen
E-Mail: eucera@paul-westrich.de

Andreas Knapp, Rosenweg 6/2,
D-72561 Dettingen

Ingrid Berney, Magnusstrasse 28,
CH-8004 Zürich